Influence Factor Analysis of POA based on River-Spanning Approach Bridge

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Summary

Pushover analysis (POA) has become a popular tool for evaluating the seismic behaviour of structures. But such work has hitherto focused mainly on buildings, while corresponding work on bridges has been very limited. Hence, the aim of this study is to investigate influence factors of POA based on girder bridges. To three different types bridge models which are based on river-spanning approach bridge as the engineering background the elastic POA with return period about 500 years and the nonlinear POA with return period about 2500 years are carried out respectively. Then the effects of the monitoring point and lateral load pattern on the calculating accuracy of POA are studied extensively. Finally the applicable selection for monitoring point and lateral load pattern is suggested according to structural dynamic characteristic.

Keywords: POA; monitoring point; Lateral load pattern; River-Spanning Approach Bridge; dynamic characteristic

1. Introduction

POA is a nonlinear analytical tool for assessing practical seismic performance of structures. The process is to represent the structure in a spatial analytical model that accounts for all important linear and nonlinear response characteristics, apply gravity loads followed by monotonically increasing lateral loads with an invariant spatial distribution that represent approximately the dynamic characteristic, and push the structure from elastic range to cracking of unconfined concrete and yielding of longitudinal steel until the predefined target displacement or collapse state is reached. Because of its main advantage of simplicity, practicality, lower computational cost and relative good results POA has become an effective analytical tool for performance based seismic design (PBSD).

POA has also been a standard method of nonlinear performance analysis in SEAOC Vision2000[1]、ATC-40[2]和 FEMA273[3] which are the important research report of performance based seismic design and rehabilitations; NCHRP 12-49 has also suggested POA as an alternative method of highway bridge seismic design in AASHTO; POA is also a calculating tool of nonlinear seismic analysis during very rear earthquake in Code for Seismic Design of Buildings(GB 50011-2001)[5], but step-to-step procedures are not given.

Currently the research on POA has hitherto focused on buildings while corresponding work on bridges has been very limited. We should consider the main difference in the structural systems of buildings and girder bridges:

(1) Bridge extends horizontally and the mass of bridge structures mainly concentrates on superstructures while buildings extend vertically and mass distribution is more uniform;

(2) While the displacement distribution of bridges in the transversal direction is essentially complex the selection of monitoring point for POA is complex. Meanwhile the lateral displacement pattern of bridges is not corresponding to the lateral load pattern in POA, which is also error source of POA. For the slabs in buildings, which are usually considered rigid in their plane, horizontal displacement distribution is simple.

(3) Boundary conditions of bridges and connection mode between the pier and girder are relatively complex, which make influence of mode shape need to be addressed. While foundation conditions of buildings are commonly good vibration mode is relatively simple.

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